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BELL LABORATORIES RECORD

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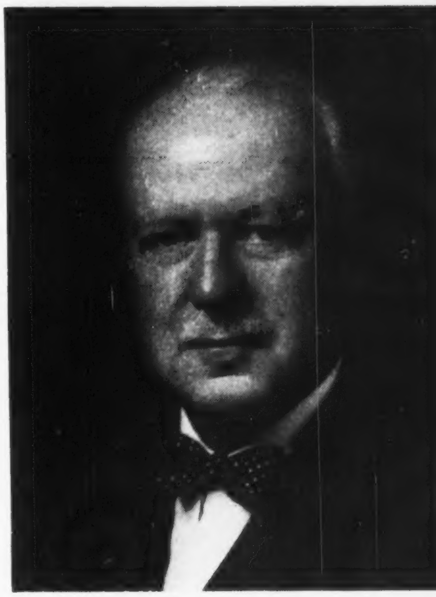
# RESPONSIBILITY OF MANAGEMENT IN THE BELL SYSTEM



BY WALTER S. GIFFORD

President, American Telephone and Telegraph Company

It used to be that the owners of practically every business were themselves the managers of the business. Today, as far as large businesses are concerned, a profound change has taken place. In the Bell System, for instance, employee management, up from the ranks, and not owner management, is responsible for running the business. This management has been trained for its job in the American ideal of respect for the individual and equal opportunity for each to develop his talents to the fullest. A little thought will bring out the important significance of these facts.

Management is, of course, vitally interested in the success of the enterprise it manages, for if it doesn't succeed, it will lose its job. So far as the Bell System is concerned, the success of the enterprise depends upon the ability of management to carry on an essential nation-wide telephone service in the public interest. This responsibility requires that management act as a trustee for the interest of all concerned: the millions of telephone users, the hundreds of thousands of employees, and the hundreds of thousands of stockholders. Management necessarily must do the best it can to reconcile the

interests of these groups. Of course, management is not infallible; but I maintain that, with its intimate knowledge of all the factors, management is in a better position than anybody else to consider intelligently and act equitably for each of these groups—and in the Bell System there is every incentive for it to wish to do so. Certainly in the Bell System there is no reason either to underpay labor or overcharge customers in order to increase the "private profits of private employers," for its profits are limited by regulation. In fact, there is no reason whatever for management to exploit or to favor any one of the three great groups as against the others and to do so would be plain stupid on the part of management. The business cannot succeed in the long run without well-paid employees with good working conditions, without adequate returns to investors who have put their savings in the enterprise, and without reasonable prices to the customers who buy its services. These conditions have been well met over the years in the Bell System.

Admittedly, this has not been and is not an easy problem to solve fairly to all concerned. However, collective bargaining with labor means that labor's point of view is forcibly presented. What the investor must have is determined quite definitely by what is required to attract the needed additional capital, which can only be obtained in competition with other industries. And in our regulated business, management has the responsibility together with regulatory authorities to see to it that the rates to the public are such as to assure the money, credit and plant that will give the best possible telephone service at all times.

Bell System employees have recently received increases in pay which management agrees are fair but which in most cases will result in earning less than an adequate return for investors pending the time management, with the approval of state regulatory authorities, secures increases in telephone rates.

It is my confident expectation that telephone management will soon again balance fairly the interests of all the parties concerned and go forward in its great task in providing more and better telephone service at a cost as low as fair treatment of employees and a reasonable return to stockholders will permit.

*Small wires are soldered, under a microscope, at the nodal points of quartz-plate vibrators. Rose Mancuso is the operator*

I. E. FAIR
Transmission
Apparatus
Development

# FT-241A FREQUENCY CONTROL UNIT

At the beginning of World War II an urgent request was received from the U. S. Signal Corps for a quartz crystal unit of radically new design to cover the relatively low frequency range from 200 to 1,040 kc. It had to be small to allow millions to be obtained from the limited supply of small quartz stones available and rugged so that large numbers could be used in portable equipment for the Armed Forces.

Quartz plates cut in the usual manner for these frequencies are too large to meet the requirements. By cutting them from the crystal at a different angle with respect to the optic axis, however, the desired range was obtained with very small plates. Figure 1 shows a comparison of a conventional 1,000-kc plate, called the AT cut, and the CT and DT cuts for frequencies used in the FT-241A unit. The CT and DT cuts were discovered prior to 1936, although commercial designs utilizing these small crystal units had not been worked out at that time.

The large difference in size between the AT and the CT plates for a given frequency results from the difference in mode of vibration. This is illustrated in Figure 2. The CT and DT cuts vibrate as a face shear in which the area of the face of the crystal determines the frequency. For square plates, the frequency times the width dimension is 3,080 kc mm for the CT cut and 2,060 kc mm for the DT cut. The frequency is not affected appreciably by the thickness of the plate. On the other hand, the AT plate vibrates in a thickness shear and the frequency is governed by its thickness and affected very little by its area. For practical sizes of plates, the frequency range for the CT is from 300 to a little over 1,000 kc and for the DT it is 200 to 500 kc. For frequencies much above 1,000 kc, the thickness vibration is commonly used and for those below 200 kc other modes are chosen.

Crystal plates were made to vibrate in face shear long before the CT and DT

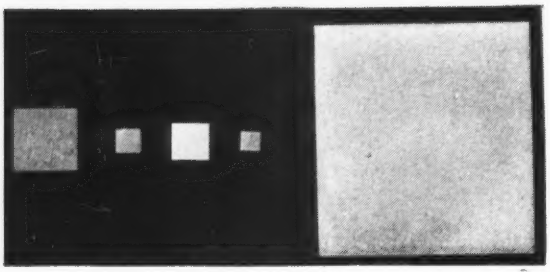


*Fig. 1—CT and DT quartz plates are miniature in size compared with the AT plate (right) that vibrates at the same frequency*

cuts were discovered. The distinguishing characteristics of these, however, is that their frequency does not change appreciably as the temperature varies. The DT cut is slightly better in this respect than the CT, as is indicated by the curves of Figure 3. The temperature at which the peak occurs is determined by the angle at which the plate is cut from the quartz. For the curves shown, the CT plate was cut at an angle of 37 degrees 20 minutes from the optic axis of the crystal and the DT plate −52 degrees 20 minutes. Deviations of 15 minutes in angle will shift these curves 10 to 15 degrees C. of temperature. Accurate cutting and grinding is therefore required to center the curves in the temperature range.

The major problem in the development of a crystal unit is to mount the crystal plate so that it will vibrate freely. It is practically impossible to provide a mounting which does not affect the motion to a small degree. A certain amount of damping is not objectionable, but it must remain constant to insure frequency and activity stability. In designing a mounting for these plates, advantage is taken of the fact that there is a nodal point at the center in this type of motion. At this infinitesimal spot the motion is zero and the crystal plate may be held there between two points. This is a fairly satisfactory method of mounting provided the crystal unit is not subjected to severe shock or vibration.

Experience in mounting large quartz plates for filter applications had shown that a very stable mounting is obtained by suspending the plate on small wires soldered at the nodal points. In attempting to apply this method of mounting to the smaller plates, many problems were encountered. For instance, the solder connections to the plate became microscopic in size and required an accuracy not attainable with the equipment then available. The high-frequency vibrations of the crystal were

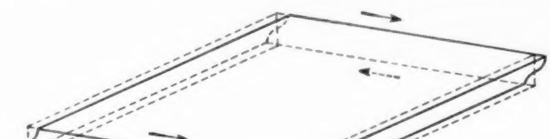



*Fig. 2—The face shear type of motion of CT and DT plates is much lower in frequency than the thickness shear, shown at the top*

transmitted to the mounting wires where the energy was absorbed, causing a decrease in activity. Other critical factors are explained below. Some of the principles used in the solution of these problems were later incorporated in the improvement of filter units.*

The step-by-step process used for mounting CT and DT plates is shown in Figure 4. A small spot of silver paste is applied at the center of the plate on each side. The plate is then heated to a high temperature

*Record, *April, 1945, page* 140.

to fire the paste and form a firmly attached silver spot. A very thin layer of silver is evaporated over the faces of the plate for the electrodes. Small phosphor bronze lead wires are soldered to the silver spots to support the plate and make electrical connections to the electrodes. Steel-spring support wires are soldered to the base of the crystal unit and a small ball of solder is placed on the end of each support wire. The plate is then fastened to the mounting by soldering the lead wires to the support wires at the balls of solder. After cleaning and adjusting to frequency, the unit is covered and sealed.

The assembly of the FT-241A crystal unit appears relatively simple until the more critical factors are understood. The further the solder spreads from the nodal point of the crystal plate, the greater will be the damping of the crystal's vibrations. If the solder area is too small, the joint will not be strong. Moreover, when the solder extends too far out on the lead wire, a complicated motion is set up in the wire by the vibrating crystal. This also results in loss and instability. If the solder does not extend far enough, the joint is weak. In short, the amount of solder must be as small as possible for the required strength and have an optimum shape. These joints will withstand a pull of from 1 to 2½ pounds, depending on the size of the wire and the amount of solder used.

Because the shape and size of the solder cone is critical, it was necessary to develop a special machine to form it. This machine is unique in that a hot air blast is used for soldering. The lead wire is carried on a spool and fed through a tip on an arm which may be moved successively to three positions. At the first position a solder pellet of the correct size is punched out and forced onto the end of the wire. The wire and solder pellet are then dipped into the soldering flux at the second position. At the third, or soldering position, hot air is blown through the nozzle at the left of the apparatus onto the solder pellet to melt it and form a uniform solder ball on the end of the wire. The crystal plate is then inserted in the centering jig which is maintained at an elevated temperature. With the preformed solder ball resting on the crystal plate, hot air is again blown onto the solder to complete the joint and form a solder cone. The soldering operation must be closely observed under a microscope and properly timed by the operator to obtain a well-shaped cone. Successive steps taken in forming the solder cone are illustrated in Figure 5. Many factors affect the results, such as temperature and the force of the air, the amount and concentration of the flux, the cleanliness of the solder and wire and the condition of the silver spot on the crystal.

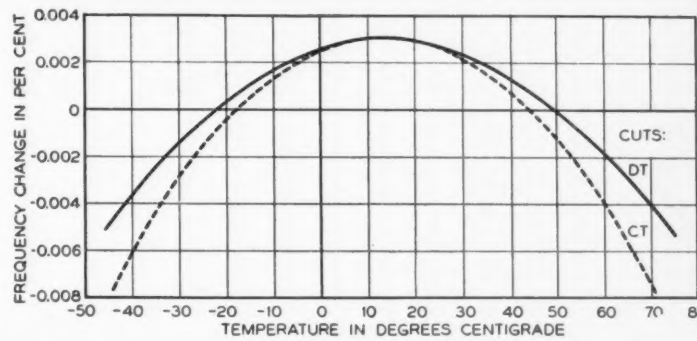



*Fig. 3—Frequency changes resulting from temperature variations are small for CT and DT quartz plates. The temperature at which the peak of the curves occurs is determined by the angle at which the plate is cut from the crystal*

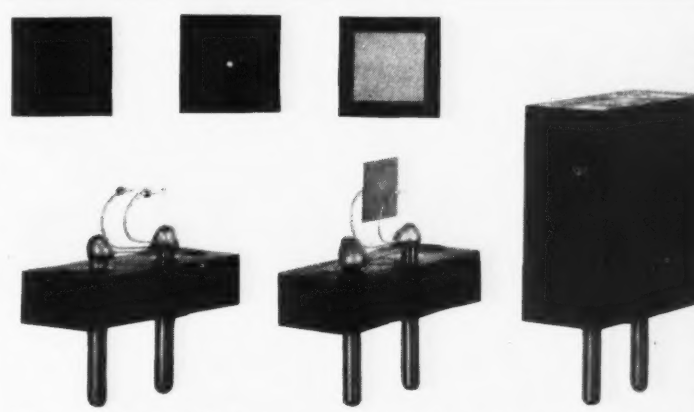


*Fig. 4—The method of mounting the quartz plate for the FT-241A crystal unit is illustrated by the different stages of the process*

The lead wires must be of definite size for a crystal plate of given dimensions to obtain adequate strength and shock-absorbing qualities. Wires 0.0035, 0.005, and

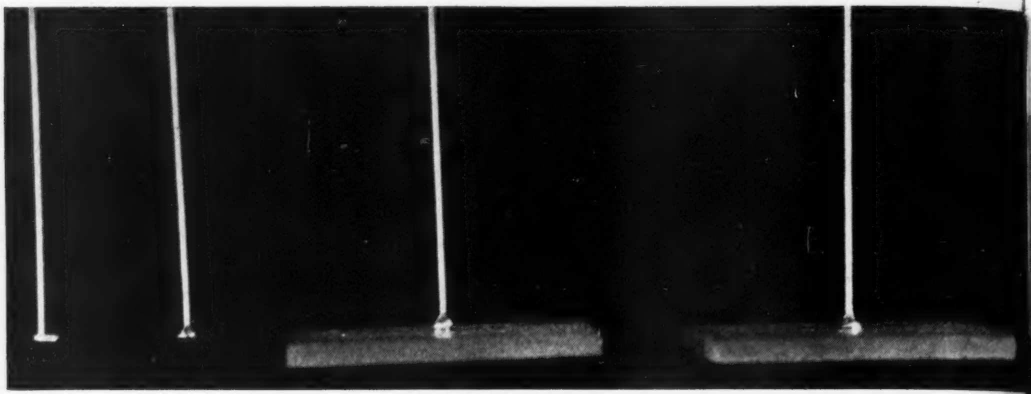


*Fig. 5—Four stages are shown in the formation of the solder cone by a hot air blast as it appears to the operator through the microscope. Magnification 10X*

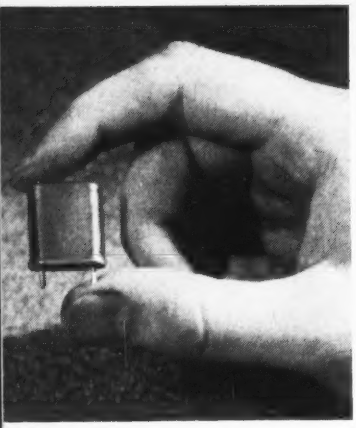


*Fig. 6—The rugged and compact FT-241A unit has been further improved by incorporating new holder designs and other developments to obtain the still smaller hermetically sealed unit shown at the left*

0.0063 inch in diameter are used to cover the range of plate sizes. Although they are soldered at the nodal point of the crystal to within one or two-thousandths of an inch, some motion of the crystal plate is transmitted to them. To prevent loss of energy into the supports, the solder balls are made sufficiently large to reflect the energy back into the crystal. The vibrations are thus confined to the length of wire between the crystal plate and solder balls. The lead wires are, therefore, part of the vibrating system and their lengths must be accurately controlled. By preventing energy from reaching the support wires, changes in them will not affect the frequency or activity of the crystal.

The FT-241A crystal unit provides stable frequencies covering a range not previously obtainable in miniature size units. It will withstand considerable vibration and shock and was, therefore, ideally suited to the needs of the Armed Forces. An improved design, including hermetic sealing and a better spring mounting, has become a standard product of the Western Electric Company, and is shown in Figure 6.

**THE AUTHOR:** Upon receiving a B.A. degree from Iowa State College in 1929, I. E. Fair joined the Radio Research Department of the Laboratories. He engaged in the first commercial ship-to-shore radio telephone tests and the investigation of special radio circuits, particularly crystal oscillator. With the increasing demand for piezoelectric crystals, he specialized in the study of crystal units and crystal oscillator circuits. During World War II his attention was turned to the development of special crystal units for the Armed Forces. In 1944 he was transferred to the Apparatus Development Department, where he has continued to develop new types of crystal units for telephone and commercial applications.

W. G. STRAITIFF
Chemical
Laboratories

# STRUCTURAL FEATURES OF GR-S RUBBER

Synthetic rubbers, including GR-S, have less tensile strength than natural rubber because their long chain molecules are not so effectively cross-linked by sulfur during vulcanization. Combined with this is the complete absence in GR-S of crystallization on stretching which reinforces natural rubber and strengthens its vulcanized structure.

GR-S is a copolymer made by combining two hydrocarbons, butadiene and styrene, in the proportions of six butadiene molecules to one of styrene. These units occur repeatedly in chain formation. Butadiene can react in two ways, either by adding styrene in the middle of the chain or at its ends, but there is no regular order in the location of these molecules in the polymer. This lack of symmetry makes it impossible for GR-S to crystallize. Since the reactive atoms are unevenly spaced, the chains cannot be uniformly cross-linked with sulfur atoms through vulcanization. In contrast, the more or less perfect chain symmetry of rubber hydrocarbon produces a vulcanizate having a greater number of sulfur cross-links.

Where side groups are located in the GR-S chain, the separation of adjacent chains will be considerably greater than in natural rubber, which has shorter methyl side groups. This wider separation may

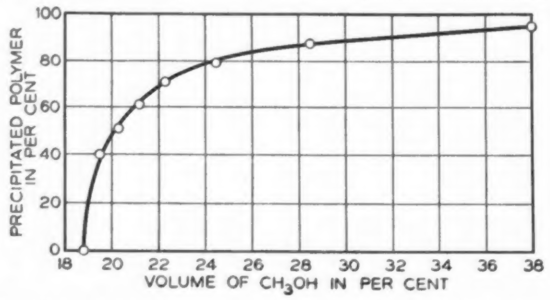



*Fig. 1—To study the different constituents of GR-S, they were precipitated from a benzene solution by successive additions of methanol (wood alcohol)*

also reduce effective cross-linking with sulfur during vulcanization and thereby cause weak areas in the vulcanizate structure. Good physical characteristics of GR-S can be obtained only by pigment reinforcement, and it is more difficult to obtain a uniform stock in conventional mixing equipment than with natural rubber because GR-S does not wet pigments so readily.

The physical properties of GR-S compounds deteriorate faster with a rise of temperature than do those of natural rubber. This is because these properties in GR-S stocks depend to a greater extent on unneutralized electrical forces in the molecules and less on chemical cross-linking than do those of similar natural rubber vulcanizates. These forces between the polymer chains and between the pigment particles and GR-S chains are greatly reduced at elevated temperatures, hence a weaker structure results than in the case of a more highly and effectively cross-linked natural rubber compound.

GR-S compounded stocks may shrink as much as 40 per cent in length when slabbed off a mill following mixing and cooling. This synthetic also lacks enough cohesive bonding to make it adhere well to itself. These defects may be due in part to the presence of a high molecular weight constituent associated with a considerable portion of soft, low molecular weight polymers in liquid form which cause a broad distribution of molecular sizes. The large molecules are highly elastic and, if deformed, they spring back when the distortion force is removed.

To study the different molecular weight constituents of GR-S, a sample of the regular product was dissolved in benzene and a 50-50 mixture by volume of methanol-benzene was slowly added. On standing overnight, the higher molecular weight fraction precipitated and settled. It was separated by decantation and congealed with alcohol. More alcohol was then added to the GR-S solution to cause further precipitation. Each point on the curve of Figure 1 represents a fraction of precipitated hydrocarbon which was removed thus by decantation

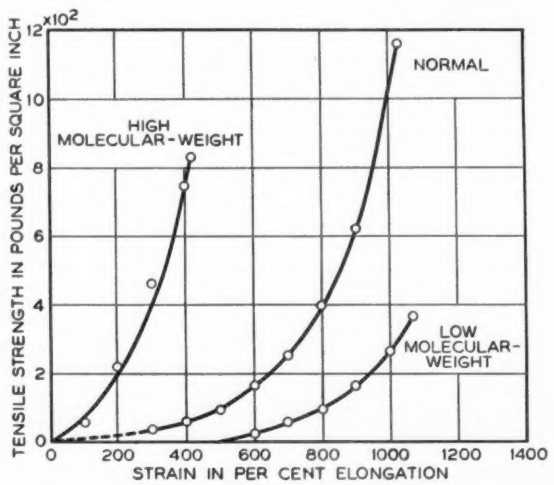



*Fig. 2—Stress-strain curves of normal and fractionated portions of GR-S compounds without fillers. These curves demonstrate the poor vulcanization characteristics of GR-S polymer molecules. Natural rubber compounds of the same type would have a tensile strength as high as $60 \times 10^2$ pounds per square inch*

of the supernatent liquid following the addition of pure alcohol. The fractions were dried under vacuum in a stream of nitrogen and weighed. The high molecular weight fractions, which precipitated at the lower alcohol concentrations, were tough and highly elastic, while those of low molecular weight, which precipitated last, were very viscous liquids. Both components are undesirable since the tough elastic polymers adversely effect processing of GR-S compounds while viscous liquid fractions lower its tensile properties. If GR-S could

be prepared with chain molecules limited to from ten to fifteen hundred carbon atoms, a much-needed improvement in processing would result but better control of the polymerization is required to accomplish this.

The effect on the physical properties of GR-S of removing the low molecular weight polymers was studied by repeatedly extracting a sample of GR-S with a fresh mixture of methanol in benzene. After three weeks the gelatinous, extracted mass was congealed with pure methanol and placed in a vacuum oven until dry. It represented 58 per cent of the original material.

The extracted GR-S was very tough, had little plasticity, and sheeted out on the laboratory mill rolls with difficulty. It resembled closely the high molecular weight fractions of GR-S rubber which had been separated by fractional precipitation. Compounds were prepared with this extracted GR-S; also two similar ones were made with the original GR-S, and one with natural rubber. After standing overnight, they were vulcanized in a mold. The cured sheets, which were 0.075 inch thick, were placed in a constant temperature humidity room for 24 hours. Results on optimum cures showed that their ultimate tensile strength was directly proportional to the molecular weight of the crude GR-S.

Physical tests showed that the presence of the low molecular weight portion of GR-S decreases its modulus of elasticity and tensile strength and increases the amount extracted by chloroform. When carbon black is present, the chloroform extracts were somewhat less. These data were

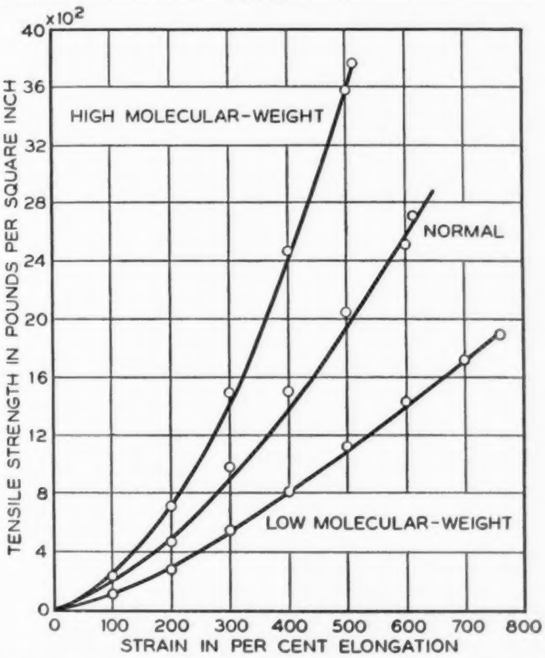



*Fig. 3–Stress-strain curves of regular and fractionated portions of GR-S tire-tread compound*

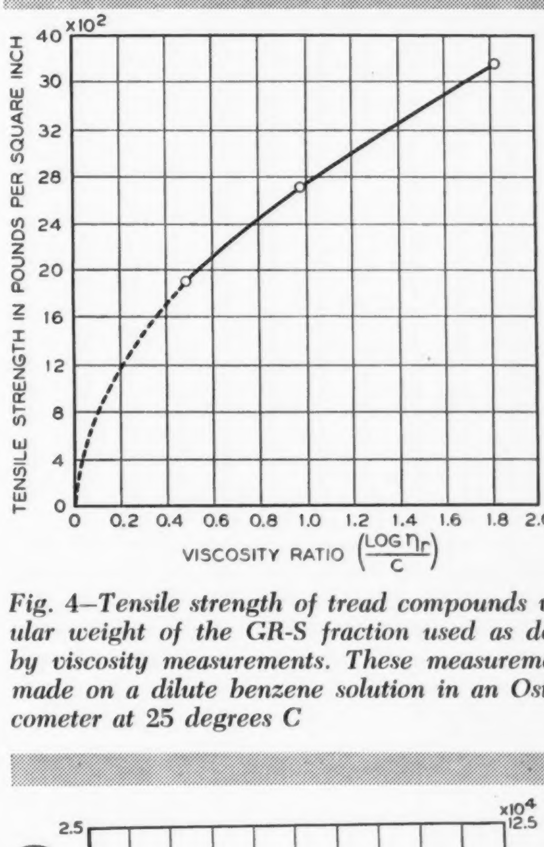



*Fig. 4–Tensile strength of tread compounds vs. molecular weight of the GR-S fraction used as determined by viscosity measurements. These measurements were made on a dilute benzene solution in an Ostwald viscometer at 25 degrees C*

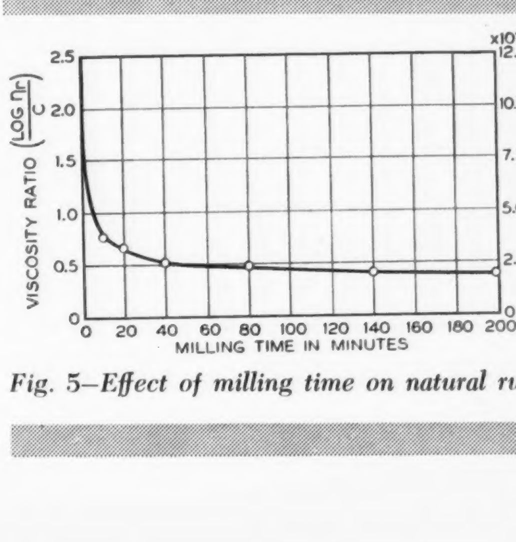



*Fig. 5–Effect of milling time on natural rubber*

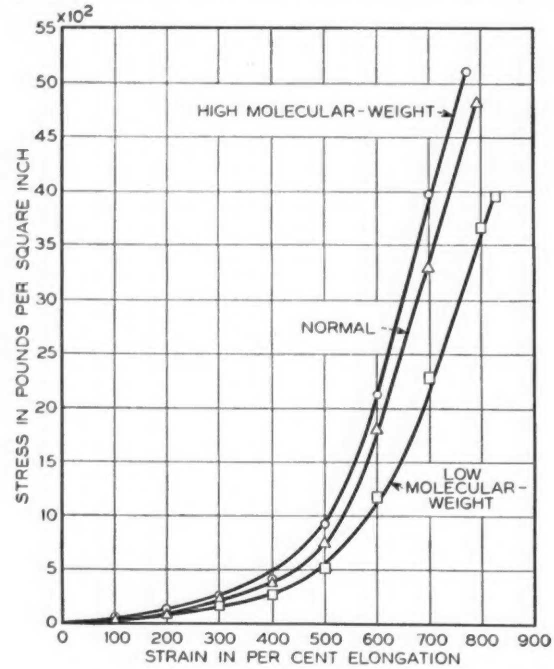



*Fig. 6—Natural rubber when compounded without fillers*

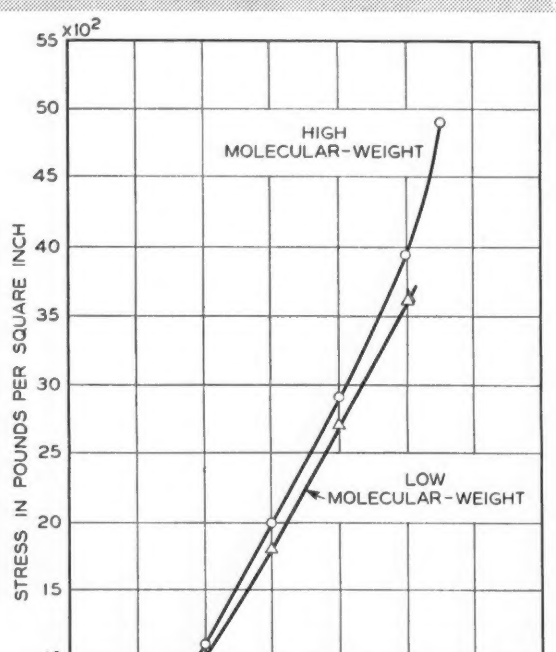



*Fig. 7—Natural rubber when used in tire compounds*

plotted and are shown in Figures 2, 3 and 4.

To study the effect of the time of milling on the physical properties of natural rubber, high, medium and low molecular weight samples were prepared by milling pale crêpe three minutes at 212 degrees F., ten minutes at 95 degrees F., and two hun-

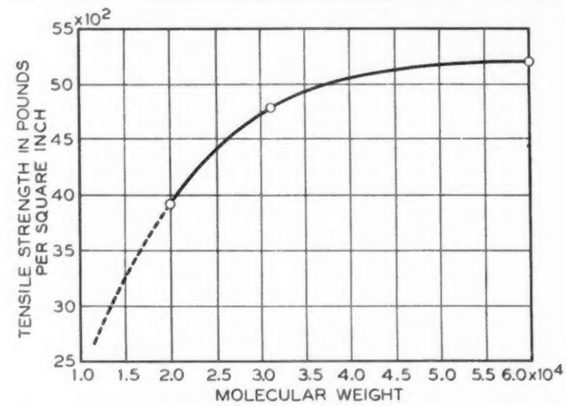



*Fig. 8—Tensile strength of compounds, without fillers*

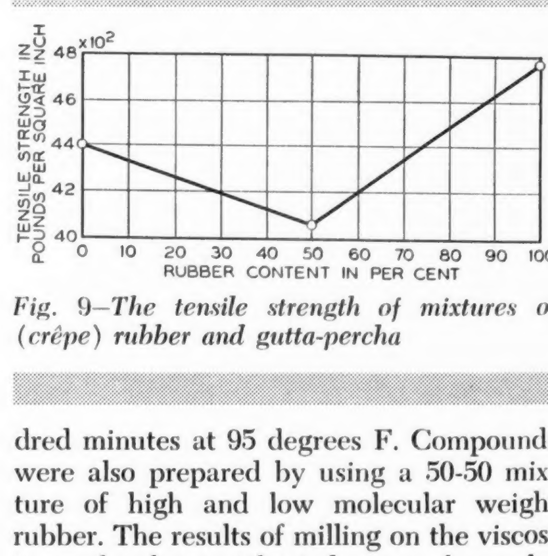



*Fig. 9—The tensile strength of mixtures of natural (crêpe) rubber and gutta-percha*

dred minutes at 95 degrees F. Compounds were also prepared by using a 50-50 mixture of high and low molecular weight rubber. The results of milling on the viscosity molecular weight index are shown by the curve in Figure 5.

Data on the stress-strain and tensile strength characteristics of natural rubber compounds without pigments are plotted in Figures 6, 7 and 8. The effect on physical properties caused by reducing the molecular weight of crêpe rubber by excessive milling is not so pronounced as that shown by the high and low fractions of GR-S. This is also true for tread stocks which contain carbon black. The low-chlo-

roform extracts found in the natural rubber compounds along with their superior physical properties is evidence that the natural product is more effectively cross-linked than GR-S during vulcanization.

By mixing crêpe rubber and leaf gutta-percha, it was thought that crystallization of each hydrocarbon might be inhibited. The object was to prevent crystallization of the gutta and rubber entirely. The gutta was presoftened in water at 195 degrees F., and the mill rolls were maintained at this temperature during mixing. The tensile strength of the optimum cure, Figure 9, was slightly lower than that of the average of the individual compounded polymers, thus showing that the two polymers were not molecularly blended. Similar mixtures made with natural rubber and GR-S also showed the same effect and a study of these compounds showed that they possessed tensile strength proportionate to the per cent of natural rubber in the mixtures.

These studies have shown how the mechanical properties of GR-S rubber reflect some of the fundamental deficiencies in its chemical structure which unfortunately cannot be corrected.

**THE AUTHOR:** William G. Straitiff did part of his undergraduate work at the Oshkosh State Teachers College and was graduated with the B.S. degree in Chemistry from the University of Chicago in 1935. He received the Ph.D. degree from the same institution in 1937. Mr. Straitiff joined the Chemistry Laboratories in August of 1937 and was associated until recently with the rubber group where he worked at first on biochemical problems connected with improving the dielectric properties of insulating compounds of natural rubber and gutta-percha. Later he was concerned with engineering problems associated with the manufacture of rubber-insulated wire and cable. At present, Mr. Straitiff is engaged in research and engineering development work connected with the growing of piezoelectric crystals.

## Temperature-Controlled Test Cabinet

This combination refrigerator and oven, developed by C. R. Meissner, is used for testing carrier equipment at any temperature between $-60$ degrees and $+160$ degrees Fahrenheit. Within this range the temperature is controlled to an accuracy better than 1 degree. To obtain temperatures below room temperature, a mixture of dry ice and alcohol is used as the refrigerant, while an electric heater is provided to obtain the higher temperatures. A blower and diffusing duct reduce the temperature gradients within the box and increase the rate of heat transfer.

*New point-type transposition being inspected by T. W. Rolph at the Chester, N. J., laboratory of Outside Plant Development*

# NEW TANDEM TRANSPOSITION

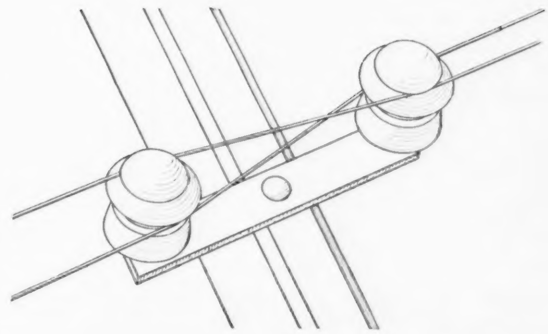
J. A. CARR
Outside
Plant
Development

If it were not for the interchanging of pin positions between the two wires of a pair on open wire lines, crosstalk between circuits and the induction of noise from power lines and atmospheric static would make telephone communication difficult and often impossible. The pattern of the transpositions varies for different circuits, which makes it necessary to carry out the work from plans and to keep records of the location of transpositions by pole number.

One of the earliest transpositions, Figure 2, employed a two-piece insulator on a single pin to provide individual wire grooves one above the other for separating the wires at the mid-point of the crossover which extended over two spans. In the usual variation of this long rolling transposition, one single-groove insulator was supported on a pin above the arm and another on a drop bracket below it. This reduced leakage between the two wires of a pair.

These rolling transpositions have proved satisfactory for voice-frequency and type-C carrier lines with short spans, but excessive crosstalk resulted in type-J carrier systems because the rolling transposition permitted larger changes in the average distances of the two wires of a pair from any third crosstalking wire than could be tolerated at J frequencies. To overcome this limitation, four single-groove insulators, Figure 3, were mounted in rectangular formation

*Fig. 1—A new "point" type transposition with two double-groove insulators arranged in tandem in place of the two pairs of insulators shown in Fig. 3*



on a metal bracket which was attached to the top of the crossarm. One pair of diagonally opposite insulators was positioned higher than the other to effect the crossing. The relatively high material and installation costs for this four-pin point transposition make its use practicable only for multi-channel systems where the per-channel cost becomes low and, as noted above, where the higher frequencies result in too much crosstalk with rolling transpositions.

Rural circuits as well as other lines require transpositions. A search was made for means of reducing the cost of constructing these lines and at the same time of improving the effectiveness of the transpositions against noise induction from power lines in order to encourage expansion of this class of service. Plant engineering expense could be reduced as well as the cost of maintaining records if a simple universal pattern of transpositions were adopted. The new R1 simplified system was designed for this purpose. It provides that each circuit shall be transposed at intervals of two spans to minimize noise and that the transpositions of adjacent circuits shall take place at alternate poles to minimize crosstalk. Variations from this regular pattern occur only at 25-pole intervals.

In the interest of economy, it was necessary to employ an inexpensive method of transposing. With the drop-bracket rolling type, however, the average distance of any wire from a disturbing power wire would differ from that of its mate and this might cause serious noise induction. The single-insulator rolling transposition was not suitable for the long spans desired to obtain low cost because there was too much danger of the two wires of a pair swinging together in the wind. A point type of transposition was necessary but the cost of the only available arrangement was prohibitive.

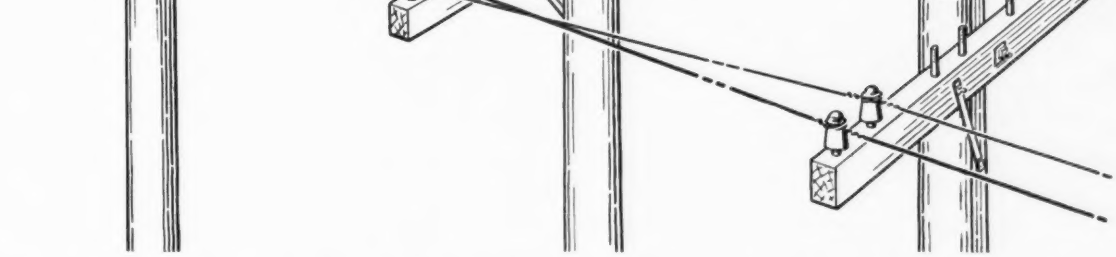


*Fig. 2—One of the earliest methods of transposing the wires of a pair required two spans and a double groove insulator at the intermediate pole*

In solving this problem, a tandem transposition was devised which mounts two double-groove insulators in line, Figure 1. These insulators are supported on steel pins about one foot apart on a steel bar which is bolted at its center on top of the crossarm. This provides a point type transposition that uses relatively inexpensive equipment and involves the utmost simplicity in installation practice. Wires can be strung over the crossarms and tensioned in long sections before they are mounted on the insulators. Positioning the wires in the insulator grooves at transposed points can be done by hand without the use of slack pulling tools and without ties, except in a few cases at corners.

Sag equality is one of the important requirements for the control of noise and crosstalk and the tandem transposition is much superior to the four-pin point type in this respect. The bracket is pivoted in the center and tends to correct small inequalities in sag that may have remained after the tensioning operation, whereas with the four-pin type even a small variation in the alignment of a crossarm will introduce sag differences.

A recent trial of the R1-system tandem transpositions on rural joint-use lines showed that the circuits were very quiet and the installing operations were simple and inexpensive. Several other applications of this principle in transposing, where its use would effect considerable economies, are being investigated.

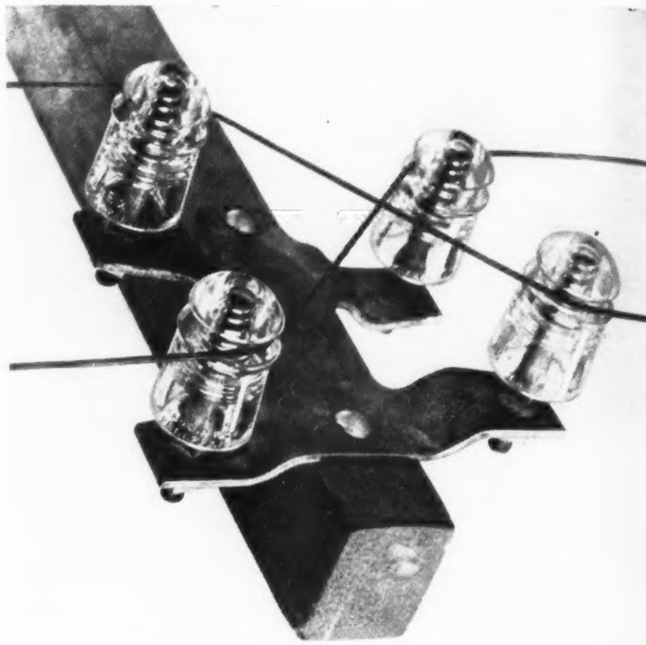


*Fig. 3—A "point" type of transposition with two pairs of single-groove insulators set at different levels to permit the wires to cross without interference. The transposition is effected within about one foot*

**THE AUTHOR:** J. A. Carr received the B.S. degree in Electrical Engineering at the Virginia Polytechnic Institute in 1919. After serving as an instructor in that subject at the Massachusetts Institute of Technology for a year, he joined the Development and Research Department of the American Telephone and Telegraph Company in 1921. In 1927 he transferred to the Laboratories, where he has since been engaged in systems development work in the Outside Plant Development Department, now at Murray Hill.

B. S. SWEZEY
Telegraph
Systems
Development

# AUTOMATIC CARRIAGE RETURN FOR RADIO TELETYPEWRITERS

Teletypewriters have been employed over radio channels to a limited extent ever since World War I, but their use greatly increased during World War II. Although disturbances that may mutilate a character are far more common over radio channels than over land lines, the occasional mutilation of a character is ordinarily of no great concern if the message is being recorded on a continuous tape at the receiving end, since the characters preceding and following the mutilated one usually permit the message to be correctly interpreted.

During the recent war, however, page teletypewriters were used at the receiving terminals of radio channels for directly recording the messages, and they are more seriously affected by hits on the radio path. Where page machines are used, two codes are sent at the end of each line to return the type carriage to the beginning of the line and to feed up the paper. When the sending operator reaches the end of the line, he depresses a "carriage-return" key and then a "line-feed" key, and each of these acts sends a code that causes the receiving teletypewriter to perform the operation indicated. Should a hit mutilate either or both of these codes, a portion of the message will be lost until the next carriage-return and line-feed signals are received. If the carriage-return signal is received, but not the line feed, the next line will be typed over the one already typed, probably making both illegible. If the carriage-return signal is mutilated, but the line feed is received correctly, all of the next line will be typed at the end of the next line. If neither carriage return nor line feed is received, the next line will all be typed at the end of the line just completed.

Teletypewriter codes comprise five time intervals during which a pulse may or may not be present, and the combinations of pulse or no pulse in five positions provide thirty-two different codes. For carriage return, the code used is a pulse in the fourth position and none in the others, whereas a line-feed code has a pulse in the second position, and none in the others, as

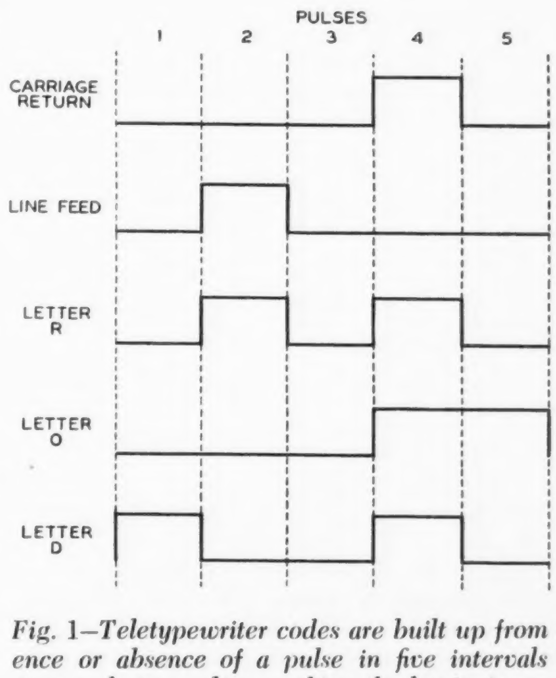



*Fig. 1—Teletypewriter codes are built up from the presence or absence of a pulse in five intervals between start and stop pulses marking the beginning and end of each code. The codes for carriage return, line feed, and the letters R, O, and D are shown above*

illustrated in Figure 1. These signals are mutilated when disturbances cause the elimination or addition of pulses. In either case, the carriage-return and line-feed code will not be received; some other code will take their place.

Other types of garbling can take place, however, because disturbances over the radio path, instead of eliminating one or both of these codes, may cause them to appear at the wrong time. The signal for some other code may be mutilated in such a way as to make it appear as a carriage-return or line-feed code. Thus the letter R, for example, having a pulse in the second and fourth positions, would become a carriage return if the pulse in the second position were lost, or would become a line-feed signal if the pulse in the fourth position were lost. There are many such codes in which a substitution would transform to carriage-return or line-feed codes. With a carriage-return signal wrongly appearing in the body of a line, the receiving teletypewriter would print the remainder of the line over the first part, making both illegible.

To avoid such mutilation of messages sent over radio paths, the Laboratories initiated the development coöperatively with the Teletype Corporation of arrangements that would insure proper carriage return and line feed regardless of mutilation of the signals sent for this purpose. The arrangements provided to take care of this situation were the outgrowth of some previous work done by the Laboratories and the Teletype Corporation. Two major changes were incorporated in the machine. One was to modify the apparatus at the receiving end so that, on receipt of the carriage-return signal, both carriage-return and line-feed operations would be performed at the receiving teletypewriter. This makes it unnecessary to transmit the line-feed signal at all. Instead, and to allow time for the physical return of the carriage, the carriage-return signal may be followed by one or more of the "letter" signals.

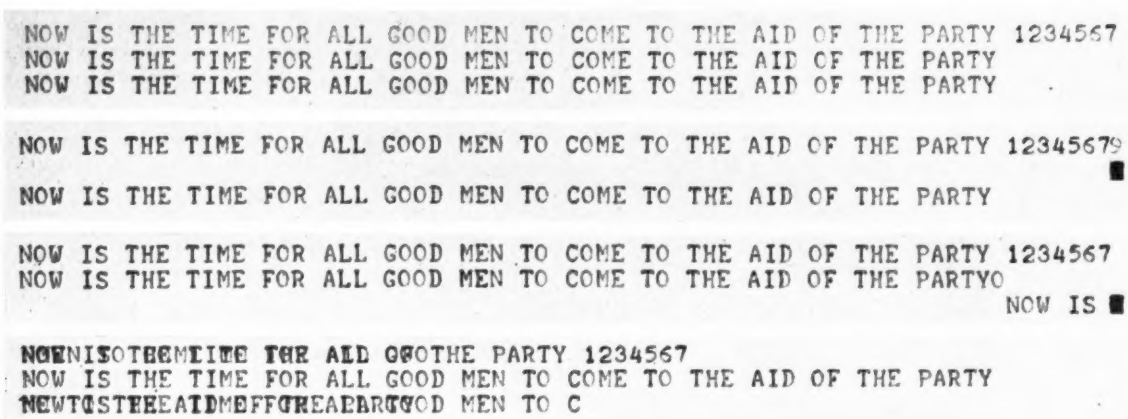

NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THE PARTY 1234567
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*Fig. 2—A three-line teletype message received correctly at the top and mutilated in the three other views. In the second, a 9 (upper case O) was received in place of the carriage-return code at the end of the first line, and as a result the entire second line piled up in the last space of the line. In the third, an O was received in place of the carriage-return code following the last word of the second line, and as a result only two words of the third line appear. At the bottom, a carriage-return signal was received in place of the D in GOOD in the first line, which resulted in obliterating all the characters up to that point, and in the third line a carriage-return signal was received in place of the O in COME, resulting in a similar garbling*

This change in itself is adequate to insure the proper action of the receiving teletypewriter most of the time. To insure proper carriage return and line feed even though the carriage-return code were lost, the second change was made. It consisted in a mechanical arrangement that operated the carriage-return and line-feed mechanisms when the type carriage reached the end of the line whether a carriage-return code was received or not. With these two changes, the mutilation of messages by or-

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NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THE PARTY 1234567
NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THE PARTY
NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THE PARTY

NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THE PARTY 1234567
NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THE PARTY
NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THE PARTY
                                                         O for "Car. Ret."
                                                        (9 in upper case)

NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THE PARTY 1234567
NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THE PARTYONOW IS
E TIME FOR ALL GOOD MENH TO COME TO THE AID OF THE PARTY
                        H of "the"        O for "Car. Ret."  T of "the"

NOW IS THE TIME FOR ALL GOO  — Car. Ret. for "D"
 MEN TO COME TO THE AID OF THE PARTY 1234567
NOW IS THE TIME FOR ALL GOOD MEN TO COME TO THE AID OF THE PARTY
NOW IS THE TIME FOR ALL GOOD MEN TO C
ME TO THE AID OF THE PARTY             Car. Ret. for "O"
```

*Fig. 3—The same transmission errors that occurred in Fig. 2 occur here, but this receiving machine is equipped with the automatic features for carriage return and line feed. As a result, the only harmful effect is the over-printing of two letters as the carriage returns or a single added (second from top) or dropped letter (bottom)*

dinary disturbances over the radio path was considerably reduced. If the carriage-return signal is lost, the mechanism on the receiving teletypewriter will return the carriage and operate the line feed at the end of the line, and should one be formed by a disturbance, the typing would merely continue on the next line, and no illegibility would result.

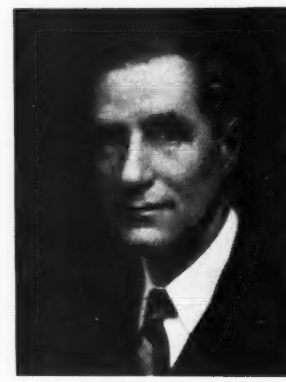
The only over-typing that can occur with these new arrangements is of one or two characters during the time the carriage is returning. As already mentioned, a short interval is required for this return, and in normal practice it is provided by the succeeding line-feed operation. When the carriage-return code is mutilated, however, or appears incorrectly in the body of the line, very little time for the return is allowed, and as a result, the following one or two characters may be printed "on the fly," and will thus appear as over-printed characters on one or the other of the two lines involved. Knowing how this error occurs, however, the receiving operator can ordinarily readily locate and identify the over-printed characters.

The sort of over-printing that may occur on radio circuits without these modifications, and how illegibility is almost entirely eliminated with them, is illustrated in Figures 2 and 3. These show an artificial three-line message correctly printed at the top, and below, the effects of various forms of mutilation before and after the new devices were installed.

For radio teletypewriter circuits employing page printers at the receiving end, these automatic carriage-return features are very helpful, and well proved their worth during the war. For wire circuits as used by the Bell System, however, they have little advantage and represent an expense that must be added to the cost of service. It is always desirable to transmit a carriage-return and a line-feed signal so that these operations will be made to take place at the end of a word rather than at the actual end of the line, that is, when 72 characters (normal length) have been typed. The time devoted to the sending of the carriage-return and line-feed signals is largely utilized by the receiving machine in performing the operations which cause the carriage to return and the paper to feed up. If this time were not allowed, and dependence placed solely on the automatic features, there would probably be over-print-

ing on almost every line. Such a degree of over-printing would normally be considered undesirable, particularly on land lines where distortions that cause a carriage-return or line-feed signal to be lost are so infrequent as to be of only minor concern. These automatic features, therefore, while very advantageous for the special conditions they were designed to meet, are not contemplated for ordinary Bell System service.

**THE AUTHOR:** Burdette S. Swezey interrupted his engineering course at the Brooklyn Polytechnic Institute in 1917 to join the U. S. Naval Service. After World War I he returned to Brooklyn Poly and received the E.E. degree in 1920. He joined the D & R at 195 Broadway, where he was associated with the development and tests of early teletypewriter machines. When switched teletypewriter service was initiated, he was concerned with the station equipment required and with teletypewriters for stations and central offices. With the 1934 consolidation, he continued the same general type of work which during World War II frequently involved problems in connection with teletypewriters used in Government Services and in the Armed Forces.



## RURAL TELEPHONE SERVICE AGREEMENTS

The Bell Telephone System and the Rural Electrification Administration have developed two model agreements expected to have a far-reaching effect in promoting the further extension of telephone service in rural areas. These agreements suggest the general form and substance of contracts which may be executed between Bell telephone companies and REA coöperatives, covering (1) the furnishing of telephone service by "carrier" methods over the coöperatives' power distribution wires, and (2) joint use of pole lines of the telephone companies and the coöperatives so that both electric and telephone wires may be carried on the same poles in many rural areas.

The way is now open, according to the A T & T, for widespread use of these two recently developed methods of bringing telephone service to more farm homes. Discussions between the Bell System and the private power companies, looking toward similar agreements, are now under way, and the United States Independent Telephone Association has indicated that telephone companies which are not a part of the Bell System are giving active consideration to contracts of similar type.

Power-line carrier telephony, developed by the Laboratories, makes it possible to transmit telephone conversations over rural electric distribution wires, and in numerous instances may prove to be the most practical and economical method of bringing telephone service to farm homes which are distant from existing telephone pole lines but close to electric power lines. Under the Bell System-REA suggested agreement covering power-line carrier, contracts between the individual telephone companies and REA coöperatives will provide that the telephone company supply and own all special equipment required to take the telephone currents onto and off the power wires. The telephone company will also maintain some of this equipment, but not that part of it directly associated with the live power wires; the latter part will be maintained by the coöperative at the telephone company's expense. For each pole belonging to the coöperative on which telephone apparatus is placed, the telephone company will pay a rental charge for the right to attach its equipment.

In the case of "joint-use" contracts which cover the placing of both telephone and power wires on the same poles, either the telephone company or the REA coöperative may be the owner of the poles. Hence the contracts will provide that on lines appropriate for joint use, either party, by paying the rental charges specified, may use the other's poles.

G. R. GOHN
Chemical
Laboratories

# MEASURING CREEP

Besides failing under too high a stress, and failing from "fatigue" when subjected to repeated stresses below their elastic limit, metals also may fail by a process known as "creep." A metal subjected to a constant tensile force well below its safe operating load may very slowly lengthen, and ultimately rupture without the stress at any time reaching the ultimate tensile strength. Temperature, as well as time and load, is one of the factors affecting creep, since at temperatures far below the melting point, creep, if it occurs at all, is generally so small as to be negligible. With metals of very high melting points, such as steel, creep at room temperature can ordinarily be ignored, but at the temperature of high-pressure steam as in turbines, or in other high-temperature apparatus, the creep of steel must be taken into account. With metals of lower melting point, such as lead and its alloys, creep at ordinary room temperatures is important, and studies of it have been carried on in these Laboratories for a number of years.

*The author making a creep measurement on a section of cable sheath by means of a cathetometer which consists of a telescope moving over a graduated scale*

Failure from fatigue* has had to be considered ever since cables have been used because of the cyclic flexure due to temperature variation to which aerial cable is subject near the supporting poles. It was not until the advent of the gas-filled cable, however, that creep entered as an important factor. The gas within the cable exerts a constant although low pressure on the sheath. At splices, where the sleeve is larger in diameter than the cable, the stress becomes greater. It was thus at the sleeve, and particularly in locations exposed to the sun, that the effects of creep first became noticeable to any extent.

It therefore became necessary to study the creep of cable sleeves under various loads, and to test many different alloys so that information would be available to permit a design that would not fail within the expected life of the cable. A large room in the basement of Building G at West Street has been given over to these tests. Samples are suspended from frames running transversely across the room. Clamped to the bottom of the specimen is a weight hanger on which may be placed the desired load. The general arrangement may be seen in Figures 1 and 2. Certain of the

*RECORD, *September*, 1934, *page* 12.

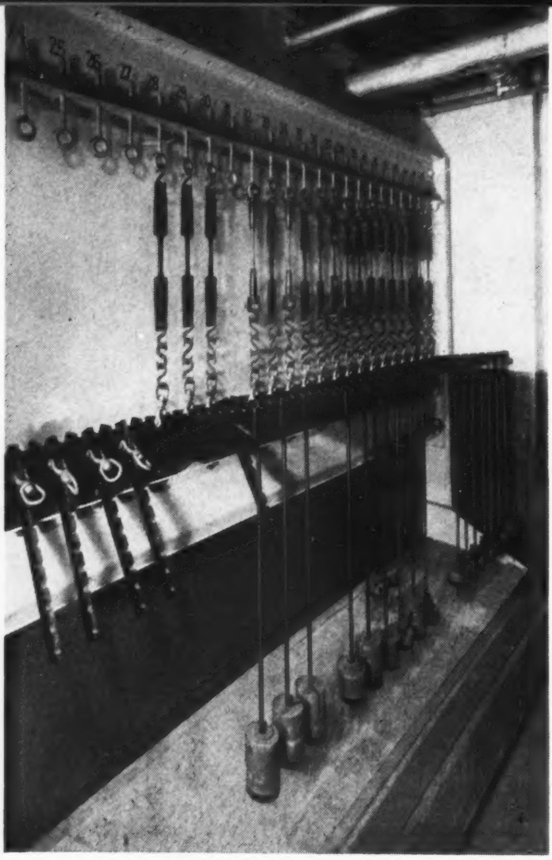


*Fig. 1—For higher stresses, the load is applied through a ten-to-one lever arm, which permits heavier loads without weights that would be difficult to lift*

frames, Figure 1, are arranged so that load may be applied through a ten-to-one lever arm, thus permitting heavier loads without requiring weights that would be difficult to lift. Some five hundred samples may be accommodated with the facilities that are provided.

Before being suspended for test, the specimen is marked with two transverse lines, either three or eight inches apart. These are used as references in determining the amount of creep. Before load is applied and periodically thereafter, the distances between these reference lines are determined with a cathetometer, as shown on page 311. This consists of a telescope moving over a graduated scale. The distance between the reference lines is determined from the difference between the scale readings of the cathetometer when the cross-hair of the telescope is moved from the upper to the lower of the two reference lines. At the beginning of a test, readings are taken at frequent intervals, but the period between readings is increased as the test progresses.

For a test on any one material, specimens are subjected to various loads, and usually two specimens are tested at each load. Results are shown graphically by plotting the per cent elongation against the elapsed time in hours. Since the test may run over a number of years, a logarithmic time scale is used. Such a graph for one particular material is shown in Figure 3. For a given alloy, the lighter the load, the longer will be the time before rupture or before any given per cent elongation. Curves showing the relationship between time-to-failure and stress-for-rupture, and between time and stress to produce five per cent elongation, are plotted in dashed lines on Figure 3. Such curves are very useful in design, since from them may be obtained the stresses that will not produce deformation exceeding a desired limit within the life of the apparatus that is involved.

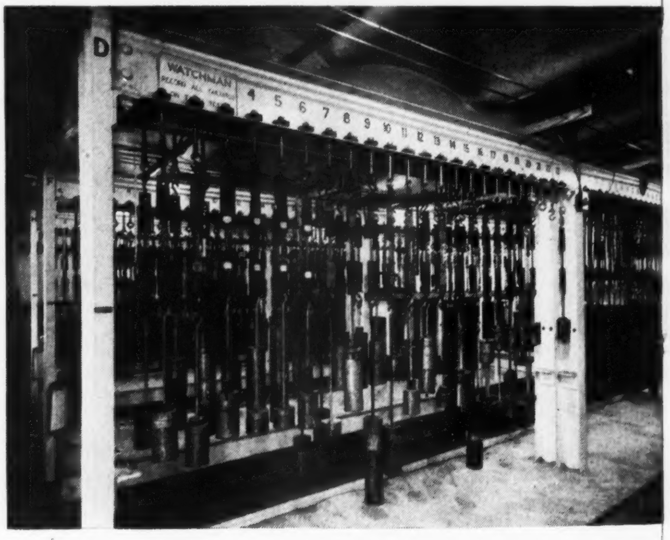



*Fig. 2—One end of the creep-test room in the basement of Building G at West Street. Placed on the bottom of a specimen is a weight hanger on which may be placed the desired load*

Since creep is a small-scale phenomenon, the test apparatus must be arranged to measure very small extensions with a maximum of accuracy. No effort is made to secure high precision in marking the reference lines, since the distance between them will be accurately measured by the cathetometer. The minimum percentage creep that can be measured will depend on the calibration of the cathetometer and on the

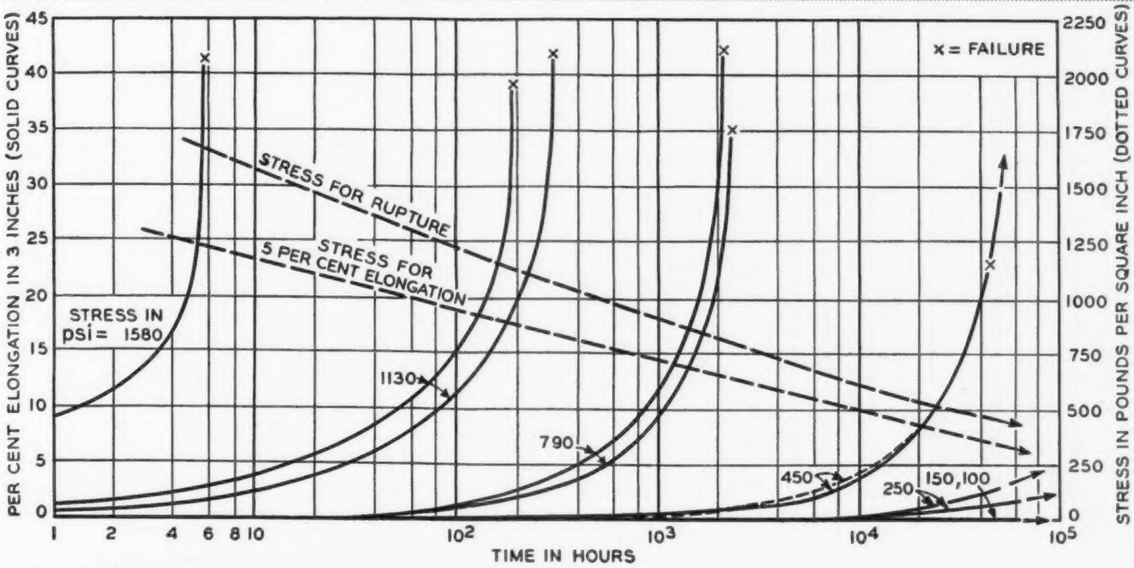



*Fig. 3—Plot of test data for one series of tests*

length of the specimen. Minimum measurable creep will be equal to the smallest difference that can be read on the vernier of the cathetometer divided by the length of the sample. Originally, three-inch samples were used, but by increasing the length to eight inches as has now been done, the minimum measurable creep has been reduced by a factor of 8 to 3 when using the same cathetometer. By using more finely graduated cathetometers, the minimum measurable creep may be still further reduced. At present, changes of only 0.00005 of an inch in length are measured.

**THE AUTHOR:** George R. Gohn was graduated from Otterbein College with an A.B. degree in 1926. He took graduate work at Ohio State University and at Columbia University, where he received a B.S. in Engineering in 1929 and the degree of Metallurgical Engineer the following June. He then joined the materials group at the Laboratories to engage in studies of non-ferrous sheet metals, die castings, and spring design. In 1932 he spent five months in the Engineer of Manufacture Department of the Western Electric Company. On returning to the Laboratories, he continued his work on metallic materials; principally studies of fatigue and forming characteristics of spring materials. During World War II he had charge of the Physical Testing Laboratory and of one section of the Microscopic Laboratory, and also acted as consultant on the application of metals to war uses. Since then, he has resumed his former activities, and is engaged chiefly in metal forming studies, and in investigations relating to fatigue, creep, and stress failures.

## CONFERENCE FOR SPEAKERS FROM ASSOCIATED COMPANIES

To inform Associated Company lecturers about post-war telephone developments and research projects in the Laboratories, a working conference was held from June 23 to July 2. The 56 men who attended are among those who tell the story of the Bell System to the public in some 10,000 lectures each year. They were here to learn what contributions the Laboratories has already made, and what it hopes to make public shortly.

Working on an intensive schedule, the men heard talks by many of the engineers who are advancing the telephone art, met them, and saw their laboratories. In this way they were able to form an intimate picture of the aims, methods and atmosphere of research which creates for the Bell System in peace and for the Armed Services in war.

Following a welcoming luncheon on Monday, June 23, R. L. Jones, R. K. Honaman, and J. O. Perrine of A T & T spoke briefly to the group in the auditorium The balance of the afternoon and the next morning were spent on *Telephone Fundamentals*, presented by W. Keister; and Tuesday afternoon, *Lecture Aid Development*, by C. D. Hanscom.

Wednesday and Thursday were spent at the Murray Hill Laboratories with talks and demonstrations on *Telephone Instruments* presented by W. C. Jones, assisted by W. L. Tuffnell, R. R. Stevens, and H. F. Hopkins; *Thermistors*, J. A. Becker and C. B. Green; *Crystals*, B. S. Woodmansee, assisted by A. C. Walker, W. G. Straitiff, E. S. Pennell and D. F. Ciccolella; *Rubber*, A. R. Kemp, assisted by F. S. Malm, V. T. Wallder, and G. N. Vacca; *Metallurgy*, E. E. Schumacher, assisted by H. C. Theuerer, G. M. Bouton, H. T. Reeve, and J. R. Boettler; *Plastics and Adhesives*, C. S. Fuller, assisted by C. J. Frosch and R. C. Platow; *Acoustics*, E. C. Wente; and *Carbon Research*, R. O. Grisdale.

Friday morning the group went to Whippany where M. H. Cook spoke on *The Whippany Laboratory and Its Current and Prospective Functions;* E. L. Nelson, *Mobile Radio and Navigational Radar Equipment;* R. E. Poole, *Military Projects;* and W. H. Doherty, *Broadcast Transmitters.* In the afternoon, at Chester, R. J. Nossaman, shown below describing the wire-swinging test line, conducted them on a tour of the property and discussed the work of the Outside Plant Development Department. Saturday morning was spent at the Long Lines building, 32 Avenue of the Americas, where J. W. Lea arranged visits to the new overseas operating and technical control rooms; microwave radio relay equipment for the New York-Boston system; radio broadcast network service; coaxial cable terminal; and other points of interest.

The tour of the West Street and Graybar-Varick buildings, covered on Monday and Tuesday of the second week, included the following: *Microchemistry*, H. V. Wadlow, assisted by Laurina O'Brien; *Radio Relay*, G. N. Thayer, assisted by A. L. Durkee, J. G. Chaffee, A. A. Roetkin, R. L. Kaylor and W. G. Domidion; *Coaxial*, L. G. Abraham; *Video Transmission*, J. F. Wentz; *Testing of High-Frequency Systems*, H. J. Fisher and O. D. Engstrom; *Instruments and Measurements*, S. J. Zammataro and E. P. Felch; *Transmission Studies*, C. H. G. Gray; *Relay and Precious Metal Contacts*, H. O. Siegmund, assisted by H. M. Knapp and E. F. Billman; *Miscellaneous Switching Apparatus and Maintenance Facilities*, D. G. Blattner; *Mobile Radio and*

Donald A. Quarles

William H. Martin

Apparatus development work of the Laboratories has been divided into two general departments. That one headed by D. A. Quarles will be concerned with switching and transmission apparatus—generally used on Telephone Companies' premises—and with apparatus for the military services and for outside sale. On July 21 Mr. Quarles was elected a vice-president of the Laboratories at a Board of Directors meeting. His new title will be Vice-President and Director of Apparatus Development—I.

The other general department will be concerned with station and outside plant apparatus, which comprises in general all items developed by Bell Laboratories for use out of doors and on the premises of telephone subscribers. Its head will be W. H. Martin, whose new title will be Director of Apparatus Development—II. Mr. Martin also has general responsibility for the work of the Quality Assurance Department.

*Radio Transmission,* S. B. Wright, assisted by A. C. Peterson and N. Monk; *Vacuum Tubes,* S. B. Ingram; *Visible Speech,* J. C. Steinberg; *Power Line Carrier,* J. M. Barstow; and *Switching Systems,* F. J. Scudder, assisted by A. J. Busch, E. B. Ferrell, D. H. Pennoyer and F. F. Shipley.

The last day of the conference proper was spent at 195 Broadway, where R. A. Nixdorf and H. J. Kostkos discussed the Bell System Display Program and the part being played in it by the A T & T and the Laboratories, respectively. At the luncheon following these talks, Keith McHugh, A T & T Vice-President in Charge of the Information Department, spoke briefly on the policies for the Bell System lecture program as outlined at the Seaview Conference. A special invitation was extended to the group by the Western Electric Company to visit the Kearny plant on the following day, and about half of the men availed themselves of the opportunity.

The initiative for holding the conference originated with J. O. Perrine, Assistant Vice-President of the A T & T, who is responsible for the general lecture program of the Bell System. Mr. Perrine arranged for representation from the various companies and extended the invitations. The conference program was arranged and supervised by C. D. Hanscom under the direction of R. K. Honaman and A. R. Thompson. Mr. Hanscom was assisted by H. J. Kostkos and J. W. Pollio. Also acting as guides were M. Brotherton, J. Campbell, Jr., and A. J. Akehurst.

## M. J. Kelly Testifies in Rate Case

In March, Dr. Kelly testified about the Laboratories' work for the Operating Companies and the Western Electric Company before the Public Utilities Commission of California in an application of the Pacific Company for an increase in intrastate rates. He was called back to California early in May for cross-examina-

tion. He used this occasion as an opportunity to visit the operating headquarters of the Associated Companies in the West and a number of universities. The headquarters of the Pacific Company in Los Angeles and San Francisco, California; Portland, Oregon; and Seattle, Washington; the headquarters of the Mountain States Company in Denver, Colorado, and Salt Lake City, Utah; and the headquarters of the Northwestern Company in Omaha, Nebraska, were visited. The universities and colleges visited were California Institute of Technology, California at Berkeley, Stanford, Washington State, Lewis and Clark, Reed, Utah, Brigham Young, Colorado and Nebraska. He also visited the Western Electric's manufacturing plant at Lincoln, Nebraska.

Dr. Kelly presented some of the impressions of his trip to an executive conference on June 11. The Operating Companies of the West are doing a good job in whittling away the "held orders" for telephone service and against heavy odds, because of shortage of facilities and manpower. Their management people are unusually smart, hard working and loyal. Their high regard for the Laboratories is a continuing challenge to us to measure up to their estimate of our abilities as well as to render them every technical assistance.

Accelerated by the war, industry is continuing its spread throughout the West. This is made strikingly evident by the large increase, since the end of the war, of power delivered to industry by the comprehensive power grid of the Northwest. All this spells telephone growth in an area whose development is small in comparison to that of the East.

Concluding, Dr. Kelly said that he returned from the trip with renewed confidence in the capacity and ability of the Laboratories to meet the ever-expanding needs of the Operating Companies for new, improved and lower cost facilities to serve the telephone public.

## F. D. Leamer Succeeds G. B. Thomas as Personnel Director

Frank D. Leamer has been appointed Personnel Director of the Laboratories, effective as of September 1. Mr. Leamer succeeds George B. Thomas, who will retire on August 31. At the time of his appointment, Mr. Leamer was Acting Personnel Planning Director. Prior to that he had been Personnel Supervisor of New Jersey Operations. Appropriate biographies and photographs will be published in the September issue of the RECORD.

Morton Sultzer has been appointed Personnel Planning Director. D. D. Haggerty and the organization handling Bell Laboratories Club and Housing activities will report to R. A. Deller, Employment Director. The remainder of Mr. Sultzer's present group continues to report to him in his new capacity.

*About 70 delegates from the International Telecommunications Conference being held at Atlantic City, New Jersey, visited the Laboratories at West Street and Murray Hill on June 16, and the same number on June 23 and July 21. Assisting in the explanation of the work performed in these Laboratories were Messrs. D. A. Quarles, R. K. Honaman, H. A. Affel, J. W. McRae, J. R. Wilson, G. N. Thayer, W. E. Viol, S. B. Ingram, J. O. McNally, C. C. Lawson, W. L. Tuffnell, J. R. Erickson, S. O. Morgan, F. S. Malm, E. E. Schumacher, W. H. Doherty and W. J. Brown.*

*Members of the Publication Department were guides for the visits to the various laboratories, assisted by Messrs. J. H. Sailliard, G. C. DeCoutouly, R. A. LeConte and K. Lutomirski, who served as French interpreters for the International delegates*

## A T & T Sets Employee Stock Plan Dates

**The Directors of the American Telephone and Telegraph Company at their meeting on July 16 voted to proceed with an offering of 2,800,000 shares of capital stock to employees of the Company and its Subsidiaries under the Employees' Stock Plan previously authorized by stockholders.**

**Employees with six months' or more service on August 31 will be eligible to participate. Officers of the A T & T will not be eligible. The purchase price will be $150 per share unless at the time payments are completed a price $20 below the market price would be less than $150, in which event the purchase price will be $20 below the market price but not less than $100 per share.**

**Eligible employees will have until October 31 to elect to purchase shares under the offer. They may elect to purchase one share of stock for each full $500 of their annual basic rate of pay on August 31, 1947, but none may buy more than 50 shares. Payment will be made at the rate of $5 per share per month, by payroll deductions beginning in December, 1947, and completed not later than May, 1950. Interest will be credited on installment payments at the rate of 2 per cent per year compounded semi-annually.**

**The Company is preparing a registration statement to be filed with the Securities and Exchange Commission and it is expected that a copy of the prospectus will be sent early in September to each of the nearly 600,000 employees eligible to purchase stock.**

**Proceeds from the sale of the stock will be used to provide funds for extensions, additions and improvements to the plant of the A T & T and its Subsidiary and Associated Companies and for general corporate purposes.**

## Report on Influenza Vaccinations

By C. E. Martin, *Medical Director*

The last eleven epidemics of influenza have been recurring in cycles which could be predicted with reasonable accuracy. As a result of these previous observations, it seemed almost certain that an influenza epidemic would occur during the winter of 1946-1947. Accordingly, last October, vaccination against influenza was offered to the members of the Laboratories and 2,866 accepted the opportunity.

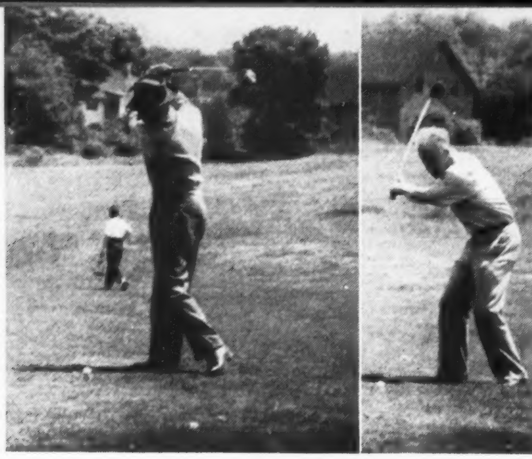
At that time it was indicated that a study would be made to determine the sickness experience of the vaccinated and unvaccinated groups. An analysis was made of unselected, consecutive illness cases causing three or more days of absence and occurring during the winter of 1947.

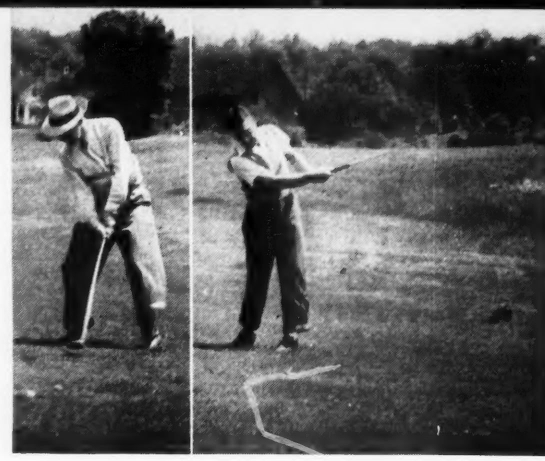
The distribution of respiratory illness was 53 per cent in the vaccinated group and 47 per cent in the unvaccinated group. The average absence of the vaccinated group was eight days and was eight and two-thirds days for the unvaccinated group. Such differences are not significant. The reason for these results is obvious. During the winter of 1946-1947 we did not have an epidemic of influenza and the vaccine is not effective against other types of respiratory disease.

The results in no way invalidate the usefulness of influenza vaccine. It has been demonstrated that the vaccine affords a high degree of protection when the disease is prevalent.

Vaccination against influenza in 1946 was done on a rather large scale throughout the country. In the Bell System alone, 120,704 were vaccinated. Vaccination was required by the Armed Forces during the war and it is still being required. Accordingly, there are many who have some protection. It is possible that this may have been a factor in forestalling the epidemic which was forecast for 1946-47.

In order to demonstrate that we were achieving a high degree of protection, we tested a volunteer group. The blood of thirty-five individuals was tested before being vaccinated and again three weeks after vaccination. In every instance it was found that the influenza immunity level had risen at least four fold.





*E. J. Johnson, F. J. Given, F. W. Treptow and F. E. Hanson (W. E. Co.) follow through*

## The Jersey Golf Tournament

Eighty-nine members and guests of the Laboratories Club participated in the golf tournament held at the Essex Country Club on June 21. Low gross winners were: *Class A,* G. A. Brodley, 79; *Class B,* H. W. Soderstrom, 91, and F. H. Graham, 93; and *Class C,* K. F. Rodgers, 98, and D. K. Gannett, 99. Kicker's prizes went to the following: *Class A,* H. M. Yates and J. F. Lawrie; *Class B,* H. L. Brown, J. E. Ballantyne and H. G. Petzinger; and *Class C,* M. Aruck, P. B. Fairlamb, E. J. Johnson and J. F. Brennan.

*W. L. Dawson, E. D. Johnson, B. W. Kendall, and E. H. Colpitts check their scores*

## Photography in Science

The First International Competition of "Photography in Science" is to be held this fall by the Smithsonian Institution and the *Scientific Monthly.* The purpose of the competition is to bring together the various techniques of photography used by scientists in all fields of science and thereby extend its possibilities for development as a basic tool in research and teaching.

The basic requirement is that all entrants shall be actively engaged in scientific research, teaching, private practice or consulting. The entries may depict experimental work, fundamental research, or experimental operations in developmental or applied research. There are no entry fees. Entries are to be received in Washington from September 25 to October 15. The accepted entries will be hung in the Smithsonian Institution from November 1 to 30, and in Chicago for display at the International Science Exhibition of the A.A.A.S. For further information, call C. T. Boyles on Extension 730 at West Street.

## News Notes

The following officers of the Telephone Pioneers, Frank B. Jewett Chapter, have been elected for the 1947-48 term: Harvey Fletcher, president; R. A. Haislip, vice-president; Marion Haggerty, R. E. Poole and J. R. Townsend, members of the Executive Committee. A. O. Jehle was re-elected treasurer and R. J. Heffner, secretary. Hattie Bodenstein is acting secretary.

Members of the Laboratories on whom degrees were conferred recently include A. E. Ruppel, who received an E.E. degree from the Polytechnic Institute of Brooklyn; E. C. Thompson, B.E.E. degree from the same institution; F. A. Thiel, M.S. in E.E.; H. M. Owendoff, M.S., and A. E. Kerwien, M.S., from Stevens Institute; C. F. Spahn, M.E., from Cooper Union; R. J. Koechlin, B.S., from New York University; L. N. Canick, M.S. in E.E., from Columbia; and Felicia R. Sanzone, B.A., from Brooklyn College.

O. E. Buckley, R. L. Jones and D. A. Quarles attended the summer meeting of the A.I.E.E. at Montreal. As guest of the Bell Telephone Company of Canada and the Northern Electric Company, Dr. Buckley addressed executives of both companies at lunch.

Dr. Buckley, on June 4, addressed the military and civilian personnel of the Signal Corps Laboratories at Fort Monmouth on the subject of military communications.

M. J. KELLY talked about his recent trip to the West at a special meeting of the Deal-Holmdel Colloquium on June 27 at Holmdel.

R. L. JONES attended the meeting of the M.I.T. Electrical Engineering Visiting Committee on June 12 in Boston. He also attended the Bell System Public Relations Conference on June 25 and 26 at Absecon, N. J.

D. A. QUARLES went to Washington for a meeting of the Committee on Electronics of the Joint Research and Development Board.

J. R. STEINBERG was elected president of the Acoustical Society of America at the May 8-10 meeting in New York City. W. KOENIG, C. A. LOVELL, H. C. MONTGOMERY and F. M. WIENER were elected Fellows, and C. M. HARRIS, a member of the Membership Committee. R. C. MATHES and R. L. MILLER presented a paper on *Phase Effects in Monaural Perception.*

M. B. GARDNER visited Dr. Julius Lempert of New York on June 26. The topic for discussion was the Fenestration operation for the restoration of hearing in otosclerosis (immobilized stapes).

JOHN BARDEEN is the author of *Surface States and Rectification at a Metal Semi-Conductor Contact* published in the May 15, 1947, *The Physical Review.*

R. M. BURNS and R. BOWN were at Swampscott, Mass., for a meeting of the Industrial Research Institute. Dr. Burns, J. R. TOWNSEND and I. V. WILLIAMS discussed new applications of aluminum alloys at the Aluminum Research Laboratory at New Kensington, Pa. A paper, *Protective Coatings for Corrosion Prevention,* by R. M. BURNS, was presented in absentia before the Chemical Institute of Canada. Dr. Burns has been appointed Secretary of the Electrochemical Society, of which he has served both as president and treasurer.

J. R. FISHER and M. D. RIGTERINK conferred on the properties and manufacture of silica gel at the Davison Chemical Corp., Baltimore.

A. C. WALKER made several trips to the Western Electric plant at Allentown. With engineers from the Allentown electronic shop at the Charles Pfizer Company chemical plant in Brooklyn, he studied chemical processing equipment. Mr. Walker visited Princeton University for the meeting of the Research Advisory Committee of the Textile Research Institute. He also visited the Rockefeller Institute for Medical Research in New York.

R. D. HEIDENREICH presented a paper, coauthored by W. SHOCKLEY, at the American Society for X-Ray and Electron Diffraction on *Electron Microscopic and Electron Diffraction Investigation of Slip in Single Crystals.* The meeting, held in Montreal, was also attended by MRS. E. A. WOOD, P. P. DEBYE, L. H. GERMER and W. L. BOND.

J. R. TOWNSEND has been elected chairman of the A.S.T.M. Committee on Methods of Test.

E. P. FELCH gave lecture demonstrations on the *Airborne Magnetometer for Geophysical Exploration* before the Philadelphia Section of the A.I.E.E. and at the Eastern Regional Meeting of the Society of Exploration Geophysicists at Mellon Institute, Pittsburgh.

W. O. BAKER and C. S. FULLER attended a conference on High Polymers sponsored by the American Association for the Advancement of Science at New London, Conn.

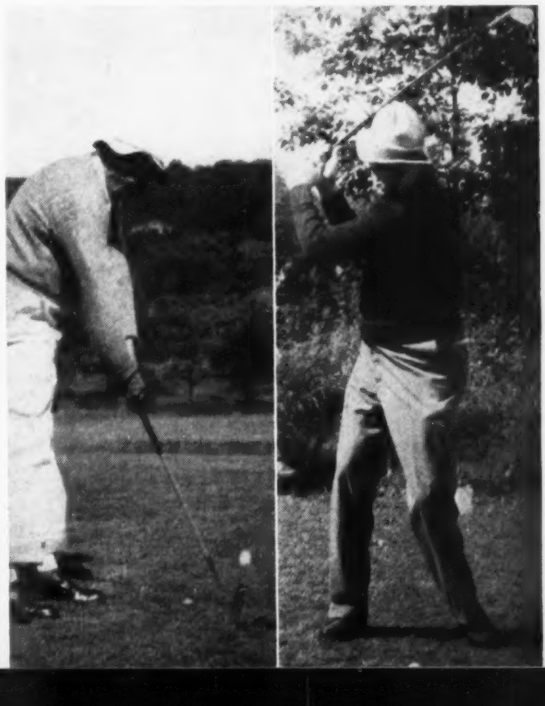
A. J. WIER visited the Wisconsin Telephone Company, Michigan Bell Telephone Company, Illinois Bell Telephone Company, and Chicago Division of the Long Lines to discuss K2 carrier projects.

H. A. LEWIS has recently returned from a visit to Dallas and other points in that vicinity regarding the L1 carrier system.

K. BULLINGTON, W. R. YOUNG, R. V. DEAN, L. A. DORFF, S. B. WRIGHT, D. MITCHELL, V. A. DOUGLAS and H. W. EVANS were in New Haven and New London in connection with the New York-Boston mobile system.

P. V. DIMOCK and H. B. COXHEAD visited the Bell of Pennsylvania to make observations on urban radio telephone systems.

*A. C. Walker and H. T. Reeve tee off on one of the short holes*



*E. H. Kampermann, a local service supervisor, confers with members of his new department. Left to right are Ruth Meyerhoff, Harold Kuhn, Mr. Kampermann, H. F. Schreiber, E. H. Backmann and Josephine Kaiser*

H. Peters, J. R. Townsend, C. J. Frosch, G. Deeg, R. Burns, K. G. Compton, John Leutritz, Jr., W. E. Campbell, F. Hardy, H. A. Birdsall and K. G. Coutlee attended the A.S.T.M. convention in Atlantic City.

R. A. Hecht investigated terminal strips used on the No. 5 crossbar office at the Media office in Pennsylvania.

V. F. Miller and F. W. Clayden, at the Schenectady step-by-step dial office, witnessed the trial of a new step-by-step bank insulator replacement tool.

At the Western Electric Company in Chicago, W. G. Turnbull discussed handset developments; R. C. Miner and R. E. Polk the manufacture of new operators' receivers; C. T. Wyman, general cable problems; W. R. Neisser and G. A. Persons, transmission apparatus for subsets; V. F. Bohman, step-by-step apparatus; J. G. Ferguson, No. 5 crossbar equipment; and C. S. Knowlton, temporary procedures required by shortages of material.

J. P. Maxfield gave a talk and demonstration in popular style on *Liveness Techniques in Broadcasting* on July 1 at Murray Hill.

M. H. Cook attended F. R. Lack's staff conference on June 16 at Winston-Salem.

J. B. Bishop spoke on *Western Electric FM Broadcast Transmitters* before the following I.R.E. Sections: Los Angeles, on June 17; San Francisco, June 19; Portland, Oregon, on June 26; and Seattle, Washington, on June 27.

The following members of the Laboratories presented papers at the Fifth Annual I.R.E. Electron Tube Conference: A. M. Clogston, C. C. Cutler, E. H. Gamble, Frank Gray, W. B. Hebenstreit, M. E. Hines, W. E. Mathews, J. A. Morton, A. T. Nordsieck, R. S. Ohl, J. R. Pierce, R. M. Ryder and W. G. Shepherd. The conference was held at Syracuse University on June 9 and 10.

G. D. Johnson discussed test problems on radar at the Fairchild Camera and Instrument Corporation in New York City.

## During the Months of April and May the United States Patent Office Issued Patents on Application Filed by the Following Members of the Laboratories

| | | | | |
|---|---|---|---|---|
| W. J. Albersheim | C. F. Edwards | D. A. S. Hale | J. B. Little | E. Peterson |
| J. A. Becker | P. G. Edwards | J. A. Hall | H. D. MacPherson | A. F. Pomeroy |
| J. H. Bollman | W. C. Ellis | W. H. T. Holden | W. P. Mason (2) | V. L. Ronci (2) |
| E. Bruce | W. B. Ellwood | K. G. Jansky | J. P. Maxfield | A. G. Souden |
| E. Buehler | O. D. Engstrom (2) | R. S. Julian | M. B. McDavitt | P. T. Sproul |
| C. J. Christensen | C. B. H. Feldman (2) | L. G. Kersta | B. McKim | J. C. Steinberg |
| H. Christensen | G. R. Frantz | A. P. King | D. A. McLean | E. R. Taylor |
| T. L. Corwin | H. T. Friis | B. J. Kinsburg | L. A. Meacham | R. G. Treuting |
| E. E. Crump | C. J. Frosch | J. J. Kleimack | D. Mitchell | E. G. Walsh |
| S. Darlington | W. M. Goodall | J. P. Laico | E. R. Morton | G. W. Willard |
| S. Doba, Jr. | H. D. Hagstrum | F. R. Lamberty | W. A. Munson | |

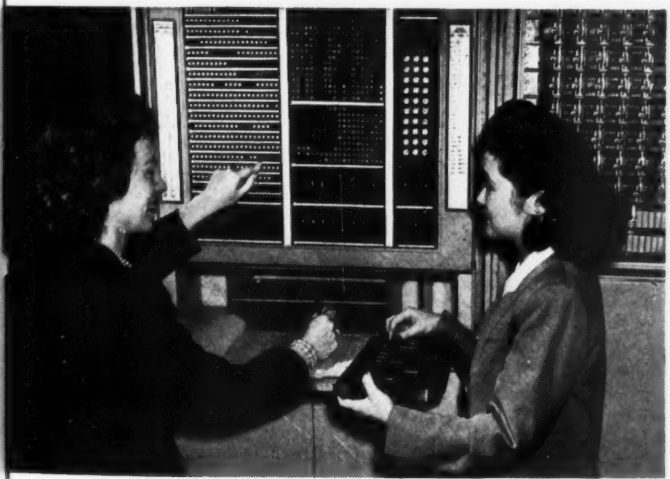
*E. J. Reilly, recently appointed Graybar-Varick Service Manager, talks over routines in Transcription with Mrs. Rose Rovegno, supervisor, who now reports to him*

B. H. NORDSTROM and J. H. HERSHEY were present at the Norfolk Naval Shipyard during the installation of fire-control apparatus on the U.S.S. *Mississippi*. Mr. Nordstrom, J. W. SMITH and F. E. NIMMKE checked the performance of special equipment which has been installed at North Beach, Maryland.

H. A. BAXTER conferred on design problems at General Mills in Minneapolis. He also visited the National Acme Corporation in Cleveland regarding modification of solenoids for radar.

J. H. HERSHEY, G. D. JOHNSON, J. B. D'ALBORA and P. H. THAYER assisted the Naval Research Laboratory in operational and performance tests on new equipment.

E. F. KROMMER visited Annapolis to discuss high impact shock tests to be conducted there, and the Naval Research Laboratory at North Beach, Maryland, to investigate various mechanical problems.



*New skills and old at the Laboratories are demonstrated by Jean Weiss (left), who operates this complex computing machine, and Kim Mee Ng who, like her forebears, can use an abacus to arrive at answers to complex sums*

W. H. C. HIGGINS and S. J. STOCKFLETH discussed subcontract work on a Government project at the Warner and Swasey Company, Cleveland. Mr. Higgins and R. R. HOUGH attended a conference on June 19 at the Stavid Engineering Company.

R. W. BENFER recently made trips to the Warner and Swasey Company, Cleveland, and to the Vinco Corporation, Detroit.

R. A. CUSHMAN visited the Applied Physics Laboratory at Silver Springs, Maryland, and the Warner and Swasey Company, Cleveland, on Government projects.

J. T. CAULFIELD conferred with the U. S. Plywood Corporation at New Rochelle.

MEMBERS of the Whippany laboratories who have made trips to Winston-Salem recently to discuss various radio projects include S. PARDEE, R. O. WISE and M. N. YARBOROUGH.

J. H. COOK and W. A. MACNAIR spoke to visitors from the post-graduate school of Annapolis at Murray Hill on *Planned Uses of Radar for Army Purposes.*

F. L. LANGHAMMER conferred with the Air Matériel Command at Dayton on antennas.

E. T. MOTTRAM has returned from Boca Raton, Florida, after spending several months there making flight tests.

W. A. FUNDA, A. D. BEERS and A. T. ROSS are installing a flight model radar in a B29 at Newark Airport. Flight tests will be made shortly out of Boca Raton Field, Florida.

S. C. HIGHT and D. B. HOLBROOK attended conferences at the Bureau of Ordnance, Washington. Mr. Hight, W. C. TINUS and R. R. HOUGH attended a three-day symposium on radar developments at the Watson Laboratories, Eatontown, N. J.

J. F. MORRISON participated in an engineering conference concerning inter-city television program transmission held by the Federal Communications Commission on June 9 in Washington. Mr. Morrison discussed broadcast development activities before a colloquium held by the Transmission Development Department at Varick Street.

## RETIREMENTS

Recent retirements from the Laboratories include A. G. Kingman with 43 years of service; R. S. Hoyt, 40 years; L. Von Nagy, 35 years; and H. E. Ives, 27 years.

### Herbert E. Ives

Dr. Ives received the B.S. degree from the University of Pennsylvania in 1905, and then, after two years as a fellow in physics, the Ph.D. degree from Johns Hopkins University in 1908. He then spent a year as assistant physicist in the Bureau of Standards, and in 1909 was appointed physicist to the National Electric Lamp Association of Cleveland. Three years later he became physicist to the United Gas Improvement Company. In 1918 he entered the United States Air Service as captain in charge of the development of methods and instruments for airplane photography.

Discharged at the end of World War I with the rank of Major, Dr. Ives joined the technical staff of Bell Telephone Laboratories. His first work was on electrical contacts, which was followed by investigations of photoelectric cells and of their possible uses in the communication industry. He was in charge of the general development of picture transmission over telephone lines which was first used at the national political conventions in 1924, at the inauguration of President Coolidge in 1925, and is now in daily operation throughout the country. Following this, Dr. Ives had charge of the investigation of television which resulted in the first demonstration from Washington to New York in April, 1927 (see *Television–20th Anniversary,* Record, *May,* 1947). Two months later television images in color were demonstrated, achieved by the use of three transmission lines, one for each primary color. In 1928, outdoor

H. E. Ives

R. S. Hoyt

television pick-up by sunlight was shown, and in 1930 a two-way television system was set up between 195 Broadway and 463 West Street. In 1937, motion pictures of high definition were sent over the coaxial cable between New York and Philadelphia, successfully demonstrating the possibility of network distribution of television programs.

Other scientific developments of Dr. Ives include the production of "parallax panoramagrams"–flat pictures which show relief from any direction of observation without the use of any apparatus at the eyes, and the laboratory demonstration of third-dimensional motion pictures by application of the same principles. More recently he has been interested in the more purely scientific field. His experimental verification of the change in rate of a moving atomic clock, by spectroscopic observation of high-speed hydrogen canal rays, furnished the first direct proof of the system of compensation for motion embodied in the theories of Larmor, Lorentz and Einstein. During World War II he worked with the National Defense Research Committee on devices for facilitating

## August Service Anniversaries of Members of the Laboratories

40 *years*

R. A. Haislip

35 *years*

John Bachor
R. B. Buchanan
W. G. Schaer
B. O. Templeton

30 *years*

T. C. Campbell
F. J. Hickman
C. E. Hollister
J. C. Jeskie
L. C. Roberts
G. T. Roggeman
H. H. Schneckloth
C. R. Steiner
C. L. Van Inwagen, Jr.

25 *years*

V. F. Bohman
Marjorie Broderick
W. W. Brown
Dorothy Carlson
W. H. Clarkson
P. S. Darnell
H. J. Elwood
J. R. P. Goller
John Kielin
J. L. Larew
E. A. Looney
T. A. Marshall
O. H. Maurer
William Schwarz
F. J. Singer
J. C. Steinberg
Arthur Zitzmann

20 *years*

S. J. Aronchick
H. J. Berka
H. A. Bredehoft
O. B. Cook
Peter Duma, Jr.
N. D. Kanely
M. A. Logan
W. A. Munson
T. J. Pope
Benjamin Slade
H. H. Staebner
C. F. Wiebusch
H. J. Williams
C. H. Young

15 *years*

W. F. Kallensee
Fred Schank

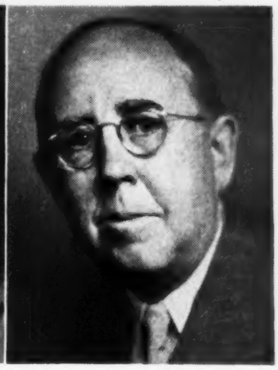
10 *years*

W. A. Depp
R. E. Graham
Milton Haigh
W. E. Ingerson
R. M. Jensen
W. A. Malthaner
J. J. Mosko
W. G. Shepherd
W. G. Straitiff
G. F. Swanson
F. O. Textor
E. C. Tundel
W. R. Young, Jr.

military operations which are used at night.

Dr. Ives is the author of many scientific and technical papers and has received three Longstreth Medals from The Franklin Institute for work in color photography, "artificial" daylight, and studies of the Welsbach mantle; the John Scott Medal, awarded annually by the City of Philadelphia for contributions to telephotography and television; and the Frederic Ives Medal of the Optical Society of America for distinguished work in optics. The honorary

L. Von Nagy



A. G. Kingman

degree of doctor of science was conferred on him by Dartmouth College and Yale University in 1928 and by the University of Pennsylvania in 1929. Dr. Ives is a past president of the Optical Society of America, a past vice-president of the Illuminating Engineering Society, and a member of the National Academy of Science, the American Association for the Advancement of Science, American Philosophical Society, American Physical Society, The Franklin Institute, Phi Beta Kappa, Sigma Xi and many other honorary and scientific organizations in the United States and in Europe.

### Ray S. Hoyt

Mr. Hoyt graduated from the University of Wisconsin in 1905 with the degree of B.S. in Electrical Engineering. He then spent a year at the Massachusetts Institute of Technology as a graduate student and assistant instructor. In June, 1906, he joined the Engineering Department of the A T & T in Boston and there he became concerned with transmission development and research. In the 1907 move to New York, Mr. Hoyt came to the Engineering Department of the Western Electric Company at West Street. Two years later he continued his education at Princeton where he received his M.S. in 1910. Returning to Western Electric, he worked for a year on the development of various repeaters and on loaded lines, and then transferred to the A T & T where he was first with the Engineering Department and then with the D & R. When the latter was consolidated with the Laboratories in 1934, Mr. Hoyt returned to West Street to what is now the Transmission Engineering Department.

During his forty years of service, Mr. Hoyt has contributed materially to the theory of loaded and non-loaded transmission lines and associated apparatus, to the theory of cross-talk and other interference, to antenna theory, and to probability theory with particular regard to applications in telephone transmission engineering. As a consultant on basic theory he has contributed in the development of many transmission systems. Twenty-one patents have been issued to him and he is the author of several papers published in the *Bell System Technical Journal.*

### A. G. Kingman

After attending Rensselaer Polytechnic Institute and the University of Vermont and spending four years in electrical work, Mr. Kingman joined the New England Telephone and Telegraph Company in 1903 as division inspector. Three years later he became division cashier and chief clerk. In 1908 he transferred to the Western Electric Company as a telephone salesman in the Philadelphia area and, four years later, came to the Advertising Department in New York. He designed and supervised the erection of that company's exhibit at the Panama-Pacific Exposition in San Francisco.

It was in 1917, after a short time in the Historical Records and Information Department, that Mr. Kingman first engaged in patent work which took him to Antwerp, Belgium, for three years. He has in recent years supervised the group which prepares and files all patents issued to the Laboratories relating to manual and toll circuits.

### "The Telephone Hour"

NBC, Monday Nights, 9:00 p.m.

| | |
|---|---|
| August 4 | *Ezio Pinza* |
| August 11 | *Maggie Teyte* |
| August 18 | *Blanche Thebom* |
| August 25 | *Zino Francesatti* |
| Sept. 1 | *Artur Rubinstein* |

### Ladislaus Von Nagy

Before joining the Bell System, Mr. Von Nagy spent two years at the Mechanics Institute, Rochester, New York, studying mechan-

*A bay of terminal equipment is swung out of a window in 4-I for shipment to a point on the New York-Boston radio-relay circuit. The bays were built by the 4-I Assembly and Wiring Shop under the immediate supervision of Jack Acker*

ical engineering. In 1911 he became a draftsman in the apparatus design group at West Street. A year later he transferred to make special studies on automatic telephone systems, particularly the automatic call-distributing system. From 1916 to 1921 he engaged in the design and development of printing telegraph systems; and since then he has been concerned with equipment development in the Systems Development Department.

## News Notes

F. B. Combs and R. G. Stephenson attended conferences on proposed modifications to Sonar equipment at the Sangamo Electric Company, Springfield, Illinois. Mr. Combs also inspected Sonar equipment at the Naval Storage Depot, Mechanicsburg, Pa.

W. A. Landy visited North Carolina in connection with the transfer of the Sonar project equipment from Whippany to Winston-Salem.

F. W. Amberg and Esther Rentrop, at Ironton, Ohio, made carrier-frequency measurements on an open-wire toll line having experimental tandem and standard transpositions.

H. B. Noyes was in Selma, Alabama, for crosstalk and attenuation measurements on open-wire pairs intended for type-M systems.

S. B. Kent appeared before the Board of Appeals at the Office in Washington relative to applications for patent.

J. E. Greene, Jr., and G. F. Drum of A T & T visited the New England Telephone and Telegraph Company at Boston to discuss No. 5 crossbar equipment.

J. M. Duguid and V. T. Callahan, with F. K. Rowe of A T & T, discussed reserve engine problems with the New England Telephone and Telegraph Company in Boston.

H. H. Spencer visited Baldwin, Wisconsin, regarding power equipment for type-L carrier.

The Laboratories were represented in interference proceedings at the Patent Office by N. S. Ewing before the Primary Examiner and by J. W. Schmied before the Examiner of Interferences.

H. C. Hart was at the Patent Office during June in connection with patent matters.

T. H. Crabtree was in Newton, Mass., for conferences at the Raytheon Manufacturing Company on the use of subminiature vacuum tubes in hearing aids.

G. W. Meszaros, at Waycross, Ga., observed a trial installation of rectifier-inverters.

J. L. Larew spent two weeks at Detroit with a group of Bell System associated company personnel being trained in the Diesel Engine Maintenance School of General Motors.

P. T. Haury went to the Long Lines station at Albany in connection with the trial of a new vacuum tube for the K2 Carrier.

F. J. Skinner went to Albany, Glen Falls and Bay Shore as a special observer during the cutover of the state-wide police radio telephone networks.

G. C. Reier, with T. J. Talley of A T & T, visited Chicago to discuss exchange plant crosstalk problems with Illinois Bell Telephone Company engineers.

H. T. King made crosstalk and transmission measurements from June 3 to 12 on type-J systems between Knoxville and Chattanooga. He also visited Dayton and Harriman, Tenn.

L. R. Cox, W. D. Mischler and R. L. Tambling, at Minneapolis, Stevens Point, Wis., and Chicago, witnessed tests on the first commercial installation involving program transmission over L1 carrier systems.

R. M. C. Greenidge and P. G. Clark were at Point Breeze discussing cable terminals.

W. K. Oser observed shipments of specially packed drop wire at Cleveland.

A. A. Heberlein and H. C. Fleming, accompanied by H. N. Moore of the Long Lines, initiated a field trial in Albany of a special design of 374A vacuum tube.

BELL LABORATORIES

RECORD